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(54) **METHOD AND APPARATUS FOR MANUFACTURING AIR CUSHION**

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Description

[0001] Conventionally, when an object, for example electrical equipment, equipment for office automation, precision instruments and works of art, is to avoid being damaged in transit, a cushion has been stuffed in a packing box to protect the packed object.

[0002] As the aforementioned cushion material, foam plastic block and so on have been used for a long time.

[0003] However, lately, in view of the environmental problems, other cushion materials have been required instead of the foam plastic block, which is difficult to dispose of.

[0004] Answering this requirement, an air cushion, more particularly of a bubble type which is formed by blowing air into a plastic-film bubble has been used.

[0005] As the above air cushion, a pillow bubble type having an almost tubular bubble, a tetrahedral bubble type having a regular tetrahedral bubble or the like is used. In the production of the aforementioned air cushion of the bubble type, an automatic cushion-bubble production apparatus has been developed for a small bubble, in which small bubbles are formed by simultaneously blowing air and sealing because of its simple structure.

[0006] The following are known in the prior art:

[1] Translated National Publication of Patent Application No. Hei 2-502986; a two-ply film is sent to a first roller to seal in a longitudinal direction, expanded into a tube shape by air blowing, sent to a second roller to seal in a direction transverse to the longitudinal direction, and finally, formed into plural bubbles divided by sealing in a lengthwise and transverse grid.

[2] European Patent No. 039 996 5A3: as the aforementioned [1], there are formed bubbles divided in the grid by sealing with a double stage roll.

[3] Translated National Publication of Patent Application No. Hei 5-508142: as basically the aforementioned [1], the bubbles divided in the grid by sealing in a double stage with a stamping type instead of the roll type in [1].

[4] Japanese Patent Application Laid-open No. Hei 5-4660: the bubbles divided in the grid are formed, in which a seal is formed to extend even in the direction transverse to the longitudinal direction in the first stage seal of the stamping type. And further, the bubble is extended by feeding with air through a non-sealing portion in the direction transverse to the longitudinal direction to each division, and finally, closing the non-sealing portion.

[0007] In all the methods of the aforementioned [1] to [4], the film is sealed at the first stage in the film longitudinal direction (a feeding direction), expanded by blowing air, and sealing at the second stage in the direction transverse to the film feeding direction whereby

independent air bubbles are formed.

[0008] Specifically, in the aforementioned [1] to [3], a tube with air is formed to extend in the longitudinal direction, and the middle part of the tube is sealed in the direction transverse to the longitudinal direction seal to form the independent air bubbles. This method is commonly well-known. There is no disadvantage when the relatively small tetragonal bubble is formed.

[0009] Incidentally, the aforementioned [4] takes steps to seal on both sides of the film at the first stage (a heat-sealer 8), blow air into the film forming the tube, form the longitudinal direction seal for the width of each bubble line at the middle part in the film direction transverse to the longitudinal direction and also the direction transverse to the longitudinal direction seal having an unsealed intermission portion (a 15 type), and further seal the unsealed intermission portion of the direction transverse to the longitudinal direction seal at the third stage (a heat-sealer 16). Therefore, the seal strength in the direction transverse to the longitudinal direction is increased by the double stage seal which has an air-blowing passage which is limited in the second stage and then closed. But, as pointed out in [4] the direction transverse to the longitudinal direction is sealed after air is fed into the film sealed in the longitudinal direction, this is the same as the aforementioned [1] to [3].

[0010] However, the conventional art such as the [1] to [4] as described above has a disadvantage in which reliable bubbles can not be produced, more specifically, the need of a process, which the direction transverse to the longitudinal direction seal divides at the middle of the shaped tube expanded by air in the feeding direction, caused the seal process to become difficult by the long seal measure in the direction transverse to the longitudinal direction (a disadvantage of difficulties in the direction transverse to the longitudinal direction seal in the air fed state).

[0011] And, the conventional art such as the [1] to [4] as described above has disadvantages hindering automatization for the following reasons when large bubbles are formed.

[0012] First, the large air cushion used for a large heavy object responds to the mass volume object by forming a lot of bubbles in a relatively thick film of one cushion sheet, so that the structure of the cushion is complicated (a disadvantage of structural complication when large bubbles are formed).

[0013] Second, since each bubble is formed to be larger for the large air cushion, it is difficult in the methods of the aforementioned [1] to [4] to form the bubble and blow air at the same time. For example, in the [1] to [4], it is difficult to seal suitably the direction transverse to the longitudinal direction with the film shaped into tubes. Therefore, the plural bubbles should be respectively fed with air by feeding with air in a different process from when the bubble is formed, thereby the producing process becomes complicated (a disadvantage of providing a separate process for the air feed when large

bubbles are formed).

[0014] Third, the aforementioned complicated production results in greater production costs, because it is difficult to produce a type in which the film is continuously fed from a film-roll and the structure of the automatic production apparatus for the large air bubble having a plurality of independent bubbles (a disadvantage of production complication when the large bubble is formed).

[0015] In addition, in the conventional art such as the [1] to [4] as described above, even the small bubble is formed to be in an almost rectangular shape having the same lengthwise and crosswise lengths or a rectangular shape having the longer lengthwise length (in the feeding direction), whereby it is a disadvantage that the processed film is difficult to wind up.

[0016] More specifically, the film which forms bubbles can be easily managed by, for example, winding up in the longitudinal direction (the feeding direction in production). But if the produced air cushion is to be wound up in the feeding direction (the longitudinal direction), the long bubble hinders the winding of the air cushion, so that there is a disadvantage in which the fine winding state is inferior (a disadvantage of the winding state in the bubble direction).

[0017] When a seal is formed in the direction transverse to the longitudinal direction to form the tube-like film as described above, even if a small bubble is formed on the film, a secure sealing state cannot be obtained without a difficult operation so as not to avoid having the possibility of occurrence of the inferior seal (a disadvantage in the direction transverse to the longitudinal direction seal).

[0018] Consequently, although the winding process as described above is strongly desired, actually, its practicability is poor.

[0019] FR2257501 and JP-B2-54-14560 disclose methods of forming an air cushion.

[0020] It is the first object of the present invention to provide a method for producing the air cushion and an apparatus for the same, in which they are capable of producing the air cushion having a secure seal and producing an air cushion at small cost, that can be processed easily, although the air cushion is of a largely elongate type in the transverse direction.

[0021] It is a second object of the present invention to provide an air cushion capable of easily being wound up in the longitudinal direction.

[0022] This is achieved by a method for producing a bubble type air cushion, the method comprising the steps of feeding continuously from a pair of feed rolls two overlying plastic-films and forming by heat fusion of the films at least a pair of line seals extending longitudinally in the direction of advance; blowing air to between the seals from the upstream end in the direction of advance to expand the films apart between the seals; and, sealing the films together at localised positions to form independent bubbles; and, according to a first as-

pect of the invention, such a method is characterised by forming by heat fusion of the films discontinuous transverse line seals extending transversely from the longitudinal line seals to define the bubbles bounded by the line seals.

[0023] According to a second aspect of the invention, an apparatus for producing a bubble type air cushion, comprises a film-feeding means for feeding two overlaid plastic-films; a first heat-fusion means for forming between the films a plurality of hollow bubble portions by heat-fusing the two films and for forming a communicating portion communicating with each bubble portion and extending in the feeding direction of the films; an air-blowing nozzle for blowing air into the communicating portion so as to cause each bubble portion to be expanded; and, a second heat-fusion means for locally heat-fusing the films at the communicating portion to close the bubble portions;

characterised in that the first heat-fusion means is arranged to form the bubbles by heat fusing the films together along at least a pair of longitudinal seal lines extending in the feed direction and discontinuous transverse seal lines extending transversely from the longitudinal seal lines.

[0024] According to a third aspect of the invention, a bubble type air cushion comprises two elongate plastic films laying one on top of another; a longitudinal direction seal and a transverse direction seal respectively extending in the longitudinal direction and the direction transverse to the longitudinal direction of the plastic films to be adapted to connect the two films with one another in a fused state; and a bubble formed on the inside, enclosed within the longitudinal direction seals and the transverse direction seals, to be expanded by air filled therein, the bubble having its length measure in the film transverse direction of over twice its diameter measure in the film longitudinal direction.

[0025] The air cushion according to the present invention is thus characterized by having the two elongate plastic films laying one on top of another, the longitudinal direction seals and the transverse direction seals extending respectively in the longitudinal direction and the transverse direction of the plastic films to be adapted to connect the two films with one another in a fused state, and each of the bubbles formed on the inside enclosed by the longitudinal direction seals and the transverse direction seals to be expanded by air filled therein, which the bubbles have their length measure in the film transverse direction larger than and preferably over twice its diameter measure in the film longitudinal direction.

[0026] According to the aforementioned structure, when the film is wound up in the longitudinal direction, each bubble has a longer length in the transverse direction, so that the film can certainly be wound up from the core of the winding device without hindrance.

[0027] Since at least a pair of the longitudinal direction seals and the transverse direction seals are created in a non-expanded state before air is blown, each seal is

securely formed.

[0028] The bubbles may be sealed across the bubbles in a longitudinal direction to divide the bubbles into a plural number. As a result, the size of the divided bubble can be simply selected.

[0029] It is preferable that a heat drum-roller having a non-welding groove (an air-leading groove) continuously encircling the drum-roller in the circumferential direction and communicating with bubble forming depressions on each side of the groove. The resulting continuity of the production process effects improvement in efficiency.

[0030] It is preferable that the bubble-forming depressions are formed to have a narrower width where they communicate with the non-welding groove (the air-leading groove) than other parts of the bubble-forming depressions.

[0031] The air cushion of the present invention is preferably adapted to be formed continuously with tube-like bubbles having the length of the bubble (the measure in the film direction transverse to the longitudinal direction) of over twice the diameter of the bubble (the measure in the film longitudinal direction). The diameter of the bubble usually is a range of 10-50 mm. The aforementioned tube-like bubble causes the air cushion to facilitate to be wound up and be packed with products or the like.

[0032] In the accompanying drawings:

Fig. 1 is a diagrammatic side elevational view of an apparatus of a structure in an embodiment according to the present invention;

Fig. 2 is an enlarged sectional view of a part of a heat drum-roller in the embodiment;

Fig. 3 is a fragmentary broken perspective view of a part of the heat drum-roller in the embodiment;

Fig. 4 is a fragmentary broken perspective view of a part of an air-cushion in a production process of the embodiment;

Fig. 5 is a fragmentary broken perspective view of a part of the air-cushion of the embodiment;

Fig. 6 is a side elevational view of a modification according to the present invention;

Fig. 7 is a side elevational view of another modification according to the present invention;

Fig. 8 is a plan view of another embodiment according to the present invention; and

Fig. 9 is a plan view of further embodiments according to the present invention.

[0033] Fig. 1 shows an automatic production apparatus 10 for an air-cushion according to the present invention. The automatic production apparatus 10 includes a film supply means 20, a heat drum-roller 30 and an application rubber-roller 31 as a first heat-fusion means, an air-blowing nozzle 40, and a point seal 50 as a second heat-fusion means.

[0034] The film supply means 20 has a pair of film-

feeding cylinders 21 and 22 each wound with thermoplastic resin films 23 and 24. NYLON (the name of product) #15, LLDPE #60 or the like is used as the films 23, 24. The width of the film is 60 mm.

5 [0035] The film-feeding cylinder 21 is rotatably supported under an application rubber-roller 31. The film-23 drawn out from the roll 21 is sent via a circumferential surface of the application rubber-roller 31 to the right side in Fig. 1.

10 [0036] The other film-feeding cylinder 22 is rotatably supported on the left side in Fig. 1. The film 24 drawn out from the roll 22 is sent via a tension-roller 25 to the circumferential surface of the application rubber-roller 31 and further sent to the right side in Fig. 1 together the film 23, lying one on the top of the other.

15 [0037] The heat drum-roller 30 is rotatably abutted to the application rubber-roller 31 on the upper right side in Fig. 1 across the films 23, 24, thereby the films 23, 24 are fused to one another by heat.

20 [0038] The heat drum-roller 30 is of a cylindrical type being wider in the axial direction than the films 23, 24 and is rotatably supported. The heat drum-roller 30 is heated from its inside by a heater (not shown) provided therein, to be maintained at a predetermined temperature on its surface, so that the overlaid films 23, 24 passed onto its circumferential surface are heated until the predetermined fusing temperature is reached.

25 [0039] The application rubber-roller 31 is a cylindrical type of which the axial direction is wider than the films 23, 24 having a larger diameter than the heat drum-roller 30, and is rotatably supported. The application rubber-roller 31 is heated from its inside by a heater (not shown) provided therein, to be maintained at predetermined temperature on its top surface, so that the overlaid films 23, 24 passed onto its circumferential surface are heated until the predetermined temperature is obtained.

30 [0040] On the circumferential surface of the heat drum-roller 30, an air-leading groove 32 and bubble-forming depressions 33 are formed.

35 [0041] Fig. 2 is an enlarged sectional view of the heat drum-roller 30 and Fig. 3 shows an enlarged view of a configuration of the circumferential surface of the heat drum-roller 30.

40 [0042] As shown in each drawing, the air-leading groove 32 extends circumferentially around the central surface in the axial direction of the heat drum-roller 30.

45 [0043] On the other hand, the bubble-forming depressions 33 are in the form of an irregular depression extending parallel to the axis of rotation of the heat drum-roller 30, and plural bubble-forming depressions 33 are arranged in a predetermined spacing in the circumferential direction of the heat drum-roller 30, so that the rest of the surface of the heat drum-roller 30 (lands around the bubble-forming depressions 33) is connected as a seal portion 34 with the application rubber-roller 31 to seal the films 23, 24 together by heat-fusion.

50 [0044] The bubble-forming depressions 33 communicate with one another through the air-leading groove 32

making conjunction with the depressions 33 arranged on the right and left sides of the air-leading groove 32.

[0045] Between the bubble-forming depressions 33 and the air-leading groove 32, there are communicating parts 32A having a narrower width than the other parts of the bubble-forming depressions 33.

[0046] Incidentally, the seal portion 34 is composed of a longitudinal seal portion 34A extending in the circumferential direction of the heat drum-roller 30 and a transverse seal portion extending in the axial direction of the heat drum-roller 30. The transverse seal is interrupted by the air-leading groove 32, so that the communicating parts 32A form an intermittent portion of the transverse seal.

[0047] On the circumferential surface of the application rubber-roller 31, an air-leading groove 35 is formed as a continuous non-welding groove in the circumferential direction like the groove 32 of the heat drum-roller 30.

[0048] The films 23, 24 applied to the circumferential surface of the application rubber-roller 31 are moderately softened by heat from the application rubber-roller 31 in preparation for the heat-fusion by being pressed with the heat drum-roller 30.

[0049] Incidentally, the softening causes the part facing to the air-leading groove 35 in the side of the film 23 passing from under the application rubber-roller to be maintained in a lower state than the top circumferential surface of the application rubber-roller 31 so that the film is pulled down little by little into the air-leading groove 35 by the tension of the film 23.

[0050] The air-blowing nozzle 40 is inserted between the two films 23 and 24 as they lie on top of one another on the top circumferential surface of the application rubber-roller 31 to inject compressed air fed from a feeding source of compressed air (non-shown) at a high pressure. A slenderly extended opening 41 of the nozzle 40 is extended along the air-leading groove 35 between the film 23 sinking to the air-leading groove 35, and the film 24 on top of the film 23, adjacent to the heat drum-roller 30 (see Figs. 1 and 2).

[0051] The point-seal 50 as the second heat-fusion means is provided above and below the films to catch the two films 23 and 24, drawn after the heat-fusion by the heat drum-roller 30 and the application rubber-roller 31, and provided to be capable of heating up to a predetermined fusing temperature the films 23, 24 by a heater (not-shown), and of opening and closing up and down by a driving system (not-shown), whereby each aforementioned intermittent portion is sealed by heat-fusion by pressing the films 23, 24 at a predetermined pressure and temperature.

[0052] The point-seal 50 is controlled to press at the chosen part of the films 23, 24 (a part corresponding to the conjunction of the air-leading groove 32 and the bubble-forming depressions 33 on the heat drum-roller 30) in the predetermined interval so as to heat fuse the films.

[0053] Incidentally, the point-seal 50 is used in the

embodiment because of, relatively, the small size of the sealed intermittent portion, however, the second heat-fusion may be suitably used as a larger seal, a different shape seal, utilization for a part of another seal and so on. Briefly, the second heat-fusion may be a seal forming means or the like to be able to seal the intermittent portion in the films 23, 24.

[0054] In the embodiment as structured above, the films 23, 24 are drawn from the film-feeding cylinder 21, 22 of the film supply means 20, and reach the application rubber-roller 31, lying one on top of the other on the circumferential surface of the rubber-roller 31, and advanced along with the rotation of the application rubber-roller 31, and engaging with the heat drum-roller 30 while pressing on the both circumferential sides.

[0055] Therefore, both films 23 and 24 are sealed with one another by heat-fusion in a shape corresponding to the seal portion 34 of the heat drum-roller 30 so as to form a united film (60). The united film will sometimes be called as a sheet 60.

[0056] As shown in Fig. 4, in the sheet 60, the two films 23 and 24 are heat-fused at portions 61 extending from the sides of the sheet like the teeth of a comb, however, the other portions of the films corresponding to the bubble-forming depressions 33 and the air-leading groove 32 remain in a layered state without being fused with one another.

[0057] Therefore, portions corresponding to the air-leading grooves 32, 35 form a hollow-tubing communicating portion 62 extending along the center of the films 23, 24 and a portion corresponding to the bubble-forming depressions 33 forms plural hollow bubble portions 63 communicating with the right and left sides of the communicating portion 62.

[0058] In the above state, air is blown from the air-blowing nozzle 40 and is fed through the communicating portion 62 to each bubble portion 63 to expand it. The expansive state is maintained in the sheet 60 passing from the heat drum-roller 30 by air blown continuously to the communicating portion 62.

[0059] The sheet 60 is thus passed to the point-seal 50 in the expansive state of the bubble portions 63.

[0060] As shown in Fig. 5, the point-seal 50 heat-fuses the films together by pressing at communicating conjunction areas 64 of the communicating portion 62 and each bubble portion 63. Since the heat-fusion is performed at greater width than the communicating portion 62 and each bubble portion 63, the communicating portion 62 is closed and also each bubble portion 63 is closed, whereby each bubble portion 63 becomes an independent bubble 65.

[0061] Thus, the sheet is formed as an air cushion having a lot of the independent bubbles 65 of almost tubular shape. The length of the bubble in the transverse direction is defined as, usually, being at least twice that of its diameter.

[0062] The sheet 60 as produced above is shipped, for example rolled up, or, if desired, cut off at a prede-

terminated distance and piled up.

[0063] When the sheet is cut off, since each bubble 65 is independently closed, the whole sheet is not caused to shrink although the communicating portion 62 or the aligned bubbles 65 are cut off. And further, since each bubble is long in the transverse direction, the sheet 60 can be rolled up in the longitudinal direction without difficulty.

[0064] According to the embodiment, use of the plural bubble portion 63 fed with air from the communicating portion 62 causes the air cushion (the sheet 60) having the plural independent bubbles 65 to be continuously and automatically produced, whereby the production can be simplified.

[0065] Furthermore, in the embodiment, the sheet 60 is consecutively produced by using the continuous films 23, 24, so that the efficiency of the production can be progressed satisfactorily.

[0066] And, the progressing efficiency of the production can cause the cost of producing the sheet 60 (the air cushion) to be smaller.

[0067] Incidentally, it is attempted as a reference experimentation for the aforementioned overlaid films 23, 24 to be heat fused at both edges and the sealed film is fed with air to its inside so as to be shaped into a tube extending in the longitudinal direction of the films 23, 24, and then a partitioning seal over the full width is heat-fused in the transverse direction, with the result that the heat-fusion of the partitioning seal is affected because of the inside air pressure, so it is difficult for a lot of the independent bubbles to be formed.

[0068] However, in the aforementioned embodiment according to the present invention, the portion heat-fused in the air fed state is a small area, that is the communicating conjunction area of the communicating portion 62 and each bubble portion 63, and further the communicating portion 62 or the communicating portion side of each bubble portion 63 is narrow, so that the point-seal 50 is not affected because of the inside air pressure. Furthermore, since the bubble 65 is formed by blowing air, the configuration of each bubble can be standard and uniform and the internal pressure can be increased. Consequently, the sheet 60 having plural independent bubbles 65 can be certainly produced, whereby the effectiveness of the present invention is obvious.

[0069] In the embodiment, use of the heat drum-roller 30 causes the communicating portion 62 and the plural bubble portions 63 to be formed easily by the bubble-forming depressions 33 and the air-leading groove 32 formed on the heat drum-roller 30, whereby the production efficiency is high.

[0070] The communicating parts 32A of the bubble-forming depressions 33 with the air-leading groove 32 are narrow, so that the heat-fusion can be easily and certainly carried out at the communicating parts 32A by the point-seal 50.

[0071] It is not indispensable that each communicat-

ing part 32A of the bubble-forming depressions 33 should be narrower than the other parts, so that when each bubble 65 (its width) is relatively small, the widths of the whole bubble may be the same. However, by forming as the aforementioned embodiment, although the bubbles 65 are large, if the widths of the communicating parts 32A are small, the heat-fusion seals at the communicating conjunction areas 64 can be carried out with certainty.

[0072] The seal to form each independent bubble 65 is not limited to be located at the communicating conjunction area 64 between the communicating portion 62 and each bubble portion 63, and the seal may be carried out to close, for example, along a communicating portion between the two communicating conjunction areas 64 in Fig. 5. In this case, a pair of the bubble portions 63 arranged in the right and left sides of communicating portion 62 forms one long bubble 65. The long bubbles 65 are guaranteed to have independence from the other long bubbles 65 next to one another.

[0073] Furthermore, the number of communicating portions 62 formed in a cycle of the films 23, 24 (the sheet 60) is not limited to be one but may be more than two, for example, the bubble portions 63 are formed in each right and left sides of the two communicating portions 62 to arrange the four bubbles 65 in the transverse direction of the sheet 60.

[0074] Meanwhile, in the aforementioned embodiment, the heat drum-roller 30 and the application rubber-roller 31 have respectively air-leading grooves 32, 35 in order to form the communicating portion 62 in the sheet 60, but one of the air-leading grooves 32, 35 may be omitted.

[0075] For instance, as shown in Fig. 6, although the application rubber-roller 31 is smoothly formed, the communicating portion 62 can be formed by only the air-leading groove 32 on the heat drum-roller 30.

[0076] As shown in Fig. 7, even if only the bubble-forming depressions 33 are formed on the heat drum-roller 30, the communicating portion 62 can be formed by the air-leading groove 35 being formed on the application rubber-roller 31.

[0077] The air-blowing nozzle 40 does not necessarily reach to the application rubber-roller 31. For example, the air-blowing nozzle may jet the high pressure air stream from a position before the application rubber-roller 31 or before beginning of the laying of the two films 23, 24 one on top of another to the air-leading groove 32 or the end of the communicating portion 62. As a result, the bubbles 65 can be formed by maintaining the expansive state of each bubble portion 63 by blowing the high pressure air into the communicating portion 62.

[0078] It is not limited that the opening 41 of the air-blowing nozzle 40 is adapted to be accommodated to the inside of the air-leading groove 35 on the application rubber-roller 31. When there is no air-leading groove 35 on the application rubber-roller 31, the opening 41 may be inserted between the two films 23, 24 along the cir-

cumferential surface of the application rubber-roller 31 and then reach into the air-leading groove 32 on the heat drum-roller 30.

[0079] The first heat-fusion means is not limited to be of a rotation type like the heat drum-roller 30, that is, a plain heat seal mold may be used as the heat-fusion means and the sheet 60 is formed to be heat-fused at predetermined distances while the two overlaid films 23, 24 are being intermittently advanced. However, use of the heat drum-roller of the rotation type as the aforementioned embodiment effects a continuous process, whereby the efficiency of production is good.

[0080] Incidentally, the aforementioned embodiment is structured to form the two bubbles 65 in the transverse direction, in which each pair of the bubbles branches to the right and left sides of the communicating portion 62, but the number and arrangement of bubbles are limited in the aforementioned embodiment, so that the number and arrangement of bubbles may be suitably selected to divide with the longitudinal direction seal and the transverse direction seal having the intermittent non-seal portions. And the sealing configuration on the circumferential surface of the heat drum-roller 30 may be suitably defined in response to the arrangement of the bubbles.

[0081] In Fig. 8, when the films 23, 24 overlying one on top of the other are sealed by heat, the longitudinal direction seals 81 along both sides of each film and the transverse direction seals 83 having the intermittent non-seal portions 82 are formed, after which the intermittent portions 82 are closed by point seals 85 while air 84 is blown from the intermittent portions 82, thereby bubbles 86 having a length in the transverse direction over the full width of the film are formed.

[0082] As shown in the bottom right of Fig. 8, the point seals 85 are continuously processed to form point seals 87 (illustrated with a dotted line in Fig. 8) closing between the two point seals 85 (illustrated with hatching in Fig. 8), aligned in the longitudinal direction, closing each intermittent portion 82, so that the aforementioned bubbles 86 are divided to form short bubbles 88.

[0083] Consequently, the bubbles 88 are changed in their length, for example, the two bubbles having a half width of the film in the transverse direction are arranged when the bubble is sealed at the center position of the three intermittent portions, the four bubbles having a quarter width of the film are arranged when the bubble is sealed at all these positions, and the one bubble having the half width and the two bubbles having the quarter width of the film are arranged when the bubble is sealed at two positions except the center position.

[0084] Thus, the bubbles 86 having full length can be formed and also the bubbles 86 are easily sealed in a half, quarter or the like in length, that is, the required bubbles 86, 88 are suitably selected.

[0085] Since the plural intermittent portions 82 are formed in the transverse direction seals 83, the opening width of each intermittent portion 82 can be smaller than

one long intermittent portion 82 and closing by the point seal or the like can be smoothly and certainly carried out.

[0086] In Fig. 9, a sheet 90 based on the sheet 80 in Fig. 8 forms a longitudinal direction seal 91 sealed continuously in the film advancing direction instead of the center intermittent non-seal portion 82, forms two "a pair of longitudinal direction seals" with the center longitudinal direction seal 91 and the longitudinal direction seals 81 sealed at both edges of the films, and further forms short longitudinal direction seals 92 at both sides of each intermittent portion 82 near both sides of the films.

[0087] Incidentally, each longitudinal direction seal 92 is formed to have the same distance between the mutually adjacent longitudinal direction seals 92 in the operating direction as the width of the intermittent portion 82.

[0088] A space between the short longitudinal direction seals 92 corresponds to the communicating portion 62 in the aforementioned embodiment, and each division enclosed with the longitudinal direction seals 83 in the both sides of the space and the longitudinal direction seals 81, 91 corresponds to the bubble portion 63 in the aforementioned embodiment, namely, the sheet 90 can be understood as the sheet added in the transverse direction to thereon have a further two lines with bubbles 65 in the aforementioned embodiment.

[0089] In the above sheet 90, the seals 81, 83, 91, and 92 are simultaneously formed when the films are heat-fused, and then the intermittent portions 82 are closed by the point-seals 93 while the air 84 is being blown from the intermittent portions 82 (between the short longitudinal direction seals 92 on both sides of the intermittent portions 82, thereby the two long bubbles 94 having a length in the half transverse direction of the films are formed on the same line in the film transverse direction.

[0090] Furthermore, if the point-seal 95 (illustrated with a dotted line in the bottom right of Fig. 9) are formed to cover the four positions of the short longitudinal direction seals 92 by moving its position, the intermittent portions 82 can be closed although the aforementioned point-seals 93 are omitted and further the four bubbles 96 having a quarter width of the films by dividing the aforementioned bubbles 94 having a half width of the films into two can be arranged on the same line in the film transverse direction.

[0091] In the air cushion according to the present invention, there is no special limit but the film may have a thickness of 20-10 μ m, but preferably 30-70 μ m, and a width of 30-200 cm, but preferably 40-120 cm. One bubble is almost of a tube shape extending in the transverse direction and has a diameter of 10-50 mm, but preferably 20-40 mm and a length of more than 20 mm, in which a ratio of the length to the diameter is over 2, but preferably 3-20.

[0092] The product of the present invention can be used for a cushioning material intended as a protection from collision damage in transport, in which the cush-

ioning material is used to pack a packing box with something that is required to avoid being damaged in transit, for example, electrical equipment, equipment for office automation, a precision instrument and a work of art.

Claims

1. A method for producing a bubble type air cushion, the method comprising the steps of:
 - feeding continuously from a pair of feed rolls (21,22) two overlying plastic-films (23, 24) and forming by heat fusion of the films at least a pair of line seals (81) extending longitudinally in the direction of advance;
 - blowing air to between the seals from the upstream end in the direction of advance to expand the films apart between the seals; and,
 - sealing the films together at localised positions (85) to form independent bubbles (65);
 - characterised by forming by heat fusion of the films (23, 24) discontinuous transverse line seals (83) extending transversely from the longitudinal line seals (81) to define the bubbles (65) bounded by the line seals.
2. A method according to Claim 1, wherein an auxiliary seal (92) extending from an end of a discontinuity (82) of the transverse line seals (83) in the direction of advance is formed in forming the transverse line seals.
3. A method according to Claim 2, wherein the bubbles (65) are divided in plural by another seal (91) extending in the direction of advance when the discontinuity (82) is sealed.
4. A method according to Claim 1 or Claim 2, wherein the bubbles (65) are substantially tubular with their axes extending in the transverse direction, the axial length of each bubble being over twice its diameter.
5. A method according to any one of the preceding claims, further comprising the step of using a heated drum-roller (30) having a circumferentially continued air-leading groove (32) communicating with bubble forming depressions (33) on each side of the groove.
6. A method according to any one of the preceding claims, wherein:
 - the plastic films (23, 24) are bonded together so that the longitudinal direction seals (81) and the transverse seals (83) define hollow bubble portions (63) of plastic film that extend transversely across the film and that are arranged sequentially longitudinally along the film and, simultaneously with the formation of the hollow bubble portions, a communicating tube (62) is formed by the film, said communicating tube extending longitudinally along the film and being in fluid communication with the hollow bubble portions (63) so as to define the intermediate openings (82) between the transverse seals;
 - the blowing air step is performed by blowing air into the communicating tube (62) so as to cause the expansion of the hollow bubble portions of the plastic film; and
 - the closing step is performed by heat-fusing sections (64) of the communicating tube (62) closed to close the expanded hollow bubble portions of the plastic film.
7. A method according to claim 6, further comprising the step of using the heat drum-roller (30) having plural bubble-forming depressions (33) extending in an axial direction of the circumferential surface and the non-welding groove (32) (the air-leading groove) continuously cycled in the circumferential direction to communicate in conjunction with the bubble-forming depressions (33) when the heat fusion is carried out.
8. An apparatus for producing a bubble type air cushion, the apparatus comprising:
 - a film-feeding means (21, 22) for feeding two overlaid plastic-films (23, 24);
 - a first heat-fusion means (31) for forming between the films a plurality of hollow bubble portions (63) by heat-fusing the two films and for forming a communicating portion (62) communicating with each bubble portion and extending in the feeding direction of the films;
 - an air-blowing nozzle (40) for blowing air into the communicating portion so as to cause each bubble portion to be expanded; and,
 - a second heat-fusion means (50) for locally heat-fusing the films at the communicating portion to close the bubble portions;
 - characterised in that the first heat-fusion means (31) is arranged to form the bubbles (65) by heat fusing the films together along at least a pair of longitudinal seal lines (81) extending in the feed direction and discontinuous transverse seal lines (83) extending transversely from the longitudinal seal lines.
9. An apparatus for producing the air cushion according to Claim 8, wherein the second heat-fusion means (50) is a heat drum-roller having a continu-

ous air-leading groove in a circumferential direction to correspond to the intermittent portions on a circumferential surface.

10. An apparatus according to Claim 8, wherein the first heat-fusion means (31) is a heat drum-roller (30) having a plurality of bubble-forming depressions (33) extending in the axial direction of the drum-roller and a groove (32) extending continuously in the circumferential direction and communicating with the bubble-forming depressions.

11. An apparatus according to Claim 9, wherein the bubble-forming depressions (33) have a narrower width where they communicate with the groove (32A) than other parts of the bubble-forming depressions.

12. A bubble type air cushion comprising:

two elongate plastic films (23, 24) laying one on top of another;
a longitudinal direction seal (81) and a transverse direction seal (83) respectively extending in the longitudinal direction and the direction transverse to the longitudinal direction of the plastic films to be adapted to connect the two films with one another in a fused state; and
a bubble (65) formed on the inside, enclosed with the longitudinal direction seals and the transverse direction seals, to be expanded by air filled therein, the bubble having its length measure in the film transverse direction of over twice its diameter measure in the film longitudinal direction.

13. An air cushion according to Claim 12, wherein adjacent first seal portions (83) of the transverse seals have ends that define the opening between the first portions and each second seal portion (85) is connected to the ends of the first portions that define the opening closed by the second seal portion.

14. An air cushion according to Claim 12, wherein the ends of the first seal portions (83) are provided with supplemental seals (92) that extend transverse to the first seal portions and the second seal portions are connected to the supplemental seals (92).

15. An air cushion according to Claim 13, wherein the second seal portions (92) of the transverse seals are arranged in a continuous pattern (91) so that the second seal portions abut each other and extend across the bubbles (65) so that the second seals further divide each bubble into at least two smaller bubbles.

16. An air cushion according to Claim 14, wherein the

ends of the first seal portions (83) are provided with supplemental seals (92) that extend transverse to the first seal portions and the second seal portions that close the openings between the first seal portions are connected to the supplemental seals.

Patentansprüche

1. Ein Verfahren zum Erzeugen eines Luftpolsters vom Blasentyp, das die folgenden Schritte umfaßt:

Kontinuierliches Vorschieben zweier übereinanderliegender Kunststoffolien (23, 24) von einem Paar Zufuhrrollen (21, 22) aus und Ausbilden mindestens eines Paares sich der Länge nach in Vorschubrichtung erstreckender linienförmiger Verschweißungen (81) durch Warmverschweißen der Folien;

Einblasen von Luft zwischen die Verschweißungen vom oberstromigen Ende in Richtung des Vorschubs, um die Folien zwischen den Verschweißungen auseinanderzublasen; und,

Zusammenschweißen der Folien an örtlichen Positionen (85), um unabhängige Blasen (65) zu bilden;

gekennzeichnet durch Ausbilden, durch Warmverschweißen der Folien (23, 24), von diskontinuierlichen, querverlaufenden Linienverschweißungen, (83) die sich quer von den Längslinienverschweißungen (81) aus erstrecken, um die durch die Längsverschweißungen begrenzten Blasen (65) zu definieren.

2. Ein Verfahren gemäß Anspruch 1, in dem eine Hilfsverschweißung (92), die sich von einem Ende einer Diskontinuität (82) der querliegenden Linienverschweißungen (83) in Richtung des Vorschubs erstreckt, beim Ausbilden der querliegenden Linienverschweißungen gebildet wird.

3. Ein Verfahren gemäß Anspruch 2, in dem die Luftblasen (65) durch eine weitere Verschweißung (91) in eine Vielzahl unterteilt werden, die sich in Vorschubrichtung erstreckt, wenn die Unterbrechung (82) verschweißt wird.

4. Ein Verfahren gemäß Anspruch 1 oder 2, in dem die Luftblasen (65) im wesentlichen rohrförmig sind, wobei sich ihre Achsen in Querrichtung erstrecken und die axiale Länge jeder Luftblase über zweimal ihren Durchmesser beträgt.

5. Ein Verfahren gemäß einem beliebigen der vorstehenden Ansprüche, ferner enthaltend den Schritt

des Verwendens einer erwärmten Trommelrolle (30) mit einer kontinuierlichen, in Umfangsrichtung liegenden luftführenden Rille (32), die mit blasenformenden Vertiefungen (33) auf jeder Seite der Nut verbunden ist.

6. Ein Verfahren gemäß einem beliebigen der vorstehenden Ansprüche, in dem:

Die Kunststoffolien (23, 24) zusammengefügt sind, so daß ihre in Längsrichtung laufenden Verschweißungen (81) und die querliegenden Verschweißungen (83) leere Blasenteile (63) aus Kunststoffolie definieren, die sich quer über die Folie erstrecken und der Reihe nach in Längsrichtung der Folie entlang angeordnet sind und gleichzeitig mit der Bildung der hohlen Blasenteile von der Folie ein Verbindungsrohr (62) gebildet wird, wobei sich dieses Verbindungsrohr in Längsrichtung über die Folie erstreckt und in Fluidverbindung mit den hohlen Blasenteilen (63) steht, so daß die Zwischenöffnungen (82) zwischen den Querverschweißungen definiert werden;

der Luftblasschritt durch Blasen von Luft in das Verbindungsrohr (62) ausgeführt wird, um die Ausdehnung der hohlen Blasenteile der Kunststoffolie zu bewirken; und

der Schließschritt durch Warmverschweißabschnitte (64) des geschlossenen Verbindungsrohrs (62) ausgeführt wird, um die erweiterten hohlen Blasenteile der Kunststoffolie zu schließen.

7. Ein Verfahren gemäß Anspruch 6, das ferner enthält den Schritt des Anwendens der Heiztrommelrolle (30), die eine Vielzahl blasenformender Vertiefungen (33) aufweist, die sich in axialer Richtung der Umfangsfläche erstrecken, und die nichtverschweißende Rille (32) (die luftführende Rille) kontinuierlich in Umfangsrichtung umläuft, um sich mit den blasenformenden Vertiefungen (33) zu verbinden, wenn die Warmverschweißung ausgeführt wird.

8. Ein Gerät zum Erzeugen eines Luftpolsters vom Blasentyp, wobei das Gerät umfaßt:

ein Folienvorschubmittel (21, 22) zum Vorschub zweier übereinandergelegter Kunststoffolien (23, 24);

ein erstes Warmverschweißmittel (31) zum Bilden einer Vielzahl hohler Blasenteile (63) zwischen den Folien durch Warmverschweißen der zwei Folien, und zum Ausbilden eines Ver-

bindungsteils (62), der mit jedem der Blasenteile verbunden ist und sich in der Vorschubrichtung der Folien erstreckt;

eine Luftblasdüse (40) zum Blasen von Luft in den verbindenden Teil, um zu bewirken, daß jeder Blasenteil aufgeblasen wird; und

ein zweites Warmverschweißmittel (50) zum örtlichen Warmverschweißen der Folien an den Verbindungsteilen zum Schließen der Blasenteile;

dadurch gekennzeichnet, daß das erste Warmverschweißmittel (31) so angeordnet ist, daß es die Blasen (65) durch Warmverschweißen der Folien entlang mindestens einer des Paares längsgerichteter Verschweißungslinien (81), die sich in Vorschubrichtung erstrecken, und diskontinuierlich querverlaufende Verschweißungslinien (83), die sich quer von den Längsrichtungs-Verschweißlinien aus erstrecken, ausbildet.

9. Ein Gerät zum Erzeugen eines Luftpolsters gemäß Anspruch 8, in dem das zweite Warmverschweißmittel (50) eine Heiztrommelrolle mit einer durchgehenden luftführenden Rille in Umfangsrichtung ist, um den diskontinuierlichen Teilen auf einer Umfangsfläche zu entsprechen.

10. Ein Gerät gemäß Anspruch 8, in dem das erste Warmverschweißmittel (31) eine Heiztrommelrolle (30) ist, die eine Vielzahl von blasenformenden Vertiefungen (33) aufweist, die sich in axialer Richtung der Trommelrolle erstrecken, und sich eine Rille (32) fortlaufend in Umfangsrichtung erstreckt und mit den blasenformenden Vertiefungen verbunden ist.

11. Ein Gerät gemäß Anspruch 9, in dem die blasenformenden Vertiefungen (33) eine geringere Breite haben, wo sie sich mit der Rille (32A) verbinden, als andere Teile der blasenformenden Vertiefungen.

12. Ein blasenförmiges Luftkissen, enthaltend:

zwei längliche Kunststoffolien (23, 24), die aufeinander liegen;

eine Verschweißung in Längsrichtung (81) und eine Verschweißung in Querrichtung (83), die sich entsprechend in Längsrichtung und in einer Richtung quer zur Längsrichtung der Kunststoffolien erstrecken, die so angepaßt sind, daß sie die zwei Folien miteinander in einem verschweißten Zustand verbinden; und

eine Blase (65), ausgebildet an der Innenseite,

eingeschlossen durch die Verschweißungen in Längsrichtung und Verschweißungen in Querrichtung, die durch eingefüllte Luft aufgeblasen wird, wobei die Blase ihr Längenmaß in der Querrichtung der Folie, mit über zweimal ihren Durchmesser in Längsrichtung der Folie hat.

13. Ein Luftkissen gemäß Anspruch 12, in dem anliegende erste Verschweißteile (83) der Querverschweißungen Enden aufweisen, die die Öffnung zwischen den ersten Teilen definieren und jeder zweite Verschweißteil (85) mit den Enden der ersten Teile verbunden ist, die die Öffnung definieren, die durch den zweiten Verschweißteil verschlossen ist.

14. Ein Luftkissen gemäß Anspruch 12, in dem die Enden der ersten Verschweißteile (83) mit zusätzlichen Verschweißungen (92) versehen sind, die sich quer zu den ersten Verschweißungsteilen erstrecken und die zweiten Verschweißteile mit den zusätzlichen Verschweißungen (92) verbunden sind.

15. Ein Luftkissen gemäß Anspruch 13, in dem die zweiten Verschweißteile (92) der Querverschweißungen in einem kontinuierlichen Muster (91) so angeordnet sind, daß die zweiten Verschweißungsteile aneinanderstoßen und sich quer über die Blasen (65) erstrecken, so daß die zweiten Verschweißungen jede Blase ferner in mindestens zwei kleinere Blasen unterteilen.

16. Ein Luftkissen gemäß Anspruch 14, in dem die Enden der ersten Verschweißteile (83) mit zusätzlichen Verschweißungen (92) versehen sind, die sich quer zu den ersten Verschweißteilen erstrecken, und die zweiten Verschweißteile, die die Öffnungen zwischen den ersten Verschweißteilen verschließen, mit den zusätzlichen Verschweißungen verbunden sind.

Revendications

1. Procédé de production d'un coussin pneumatique du type à bulles, le procédé comprenant les étapes consistant à :

amener en continu depuis deux rouleaux d'alimentation (21, 22) deux films plastiques superposés (23, 24) et former par fusion à chaud des films au moins deux soudures linéaires (81) s'étendant longitudinalement selon la direction d'avance ;
souffler de l'air entre les soudures depuis l'extrémité en amont selon la direction d'avance, de façon à écarter les films par gonflement entre les soudures ; et,

souder les films l'un à l'autre à des positions localisées (85), de façon à former des bulles indépendantes (65) ;

caractérisé par l'étape consistant à former, par fusion à chaud des films (23, 24), des soudures linéaires transversales discontinues (83) s'étendant transversalement depuis les soudures linéaires longitudinales (81), de façon à définir les bulles (65) délimitées par les soudures linéaires.

2. Procédé selon la revendication 1, dans lequel une soudure auxiliaire (92) s'étendant depuis une extrémité d'une discontinuité (82) des soudures linéaires transversales (83) selon la direction d'avance est formée lors de la formation des soudures linéaires transversales.

3. Procédé selon la revendication 2, dans lequel les bulles (65) sont divisées en plusieurs bulles par une autre soudure (91) s'étendant selon la direction d'avance lorsque la discontinuité (82) est soudée.

4. Procédé selon l'une des revendications 1 ou 2, dans lequel les bulles (65) sont sensiblement tubulaires, leurs axes s'étendant selon la direction transversale, la longueur axiale de chaque bulle étant supérieure à deux fois leur diamètre.

5. Procédé selon l'une des revendications précédentes, comprenant en outre l'étape consistant à utiliser un rouleau chauffant en forme de tambour (30) comportant une gorge ininterrompue d'amenée d'air s'étendant circonférentiellement (32) communiquant avec des dépressions de formation de bulles (33) de chaque côté de la gorge.

6. Procédé selon l'une des revendications précédentes, dans lequel :

les films plastiques (23, 24) sont soudés ensemble de sorte que les soudures selon la direction longitudinale (81) et les soudures selon la direction transversale (83) définissent des parties de bulles creuses (63) de film plastique qui s'étendent transversalement à travers le film et qui sont disposées longitudinalement les unes à la suite des autres le long du film et, simultanément à la formation des parties de bulles creuses, un tube de communication (62) est formé par le film, ledit tube de communication s'étendant longitudinalement le long du film et étant en communication de fluide avec les parties de bulles creuses (63), de façon à définir les ouvertures intermédiaires (82) entre les soudures transversales ;
l'étape de soufflage d'air est réalisée par soufflage d'air à l'intérieur du tube de communica-

- tion (62), de façon à provoquer le gonflement des parties de bulles creuses du film plastique ; et l'étape de fermeture est réalisée par fusion à chaud de sections (64) du tube de communication (62) fermées de façon à fermer les parties de bulles creuses gonflées du film plastique.
7. Procédé selon la revendication 6, comprenant en outre l'étape consistant à utiliser le rouleau chauffant en forme de tambour (30) comportant plusieurs dépressions de formation de bulles (33) s'étendant selon une direction axiale de la surface circonférentielle, et la gorge non destinée au soudage (32) (la gorge d'amenée d'air) effectuant un cycle continu selon la direction circonférentielle, de façon à communiquer en intersectant les dépressions de formation de bulles (33) lors de la réalisation de la fusion à chaud.
8. Dispositif de production d'un coussin pneumatique du type à bulles, le dispositif comprenant :
- un moyen d'alimentation en film (21, 22) destiné à amener deux films plastiques superposés (23, 24) ;
 - un premier moyen de fusion à chaud (31) destiné à former entre les films une pluralité de parties de bulles creuses (63) en faisant fondre à chaud les deux films, et à former une partie de communication (62) communiquant avec chaque partie de bulle et s'étendant selon la direction d'alimentation des films ;
 - une buse de soufflage d'air (40) destinée à souffler de l'air à l'intérieur de la partie de communication de façon à provoquer le gonflement de chaque partie de bulle ; et,
 - un second moyen de fusion à chaud (50) destiné à faire fondre à chaud localement les films au niveau de la partie de communication, de façon à fermer les parties de bulles ;
- caractérisé en ce que le premier moyen de fusion à chaud (31) est disposé de façon à former les bulles (65) en assemblant par fusion à chaud les films le long d'au moins deux lignes de soudure longitudinales (81) s'étendant selon la direction d'alimentation et le long de lignes de soudure transversales discontinues (83) s'étendant transversalement aux lignes de soudure longitudinales.
9. Dispositif de production du coussin pneumatique selon la revendication 8, dans lequel le second moyen de fusion à chaud (50) est un rouleau chauffant en forme de tambour comportant une gorge d'amenée d'air continue selon une direction circonférentielle destinée à correspondre aux parties discontinues sur une surface circonférentielle.
10. Dispositif selon la revendication 8, dans lequel le premier moyen de fusion à chaud (31) est un rouleau chauffant en forme de tambour (30) comportant une pluralité de dépressions de formation de bulles (33) s'étendant selon la direction axiale du rouleau en forme de tambour et une gorge (32) s'étendant de façon continue selon la direction circonférentielle et communiquant avec les dépressions de formation de bulles.
11. Dispositif selon la revendication 9, dans lequel les dépressions de formation de bulles (33) ont une largeur plus étroite à l'endroit où elles communiquent avec la gorge (32A) que les autres parties des dépressions de formation de bulles.
12. Coussin pneumatique du type à bulles comprenant :
- deux films plastiques allongés (23, 24) superposés l'un sur l'autre ;
 - une soudure selon la direction longitudinale (81) et une soudure selon la direction transversale (83) s'étendant respectivement selon la direction longitudinale et la direction transversale à la direction longitudinale des films plastiques, de façon à être conçues pour relier les deux films l'un à l'autre à un état fondu ; et
 - une bulle (65) formée à l'intérieur, entourée par les soudures selon la direction longitudinale et les soudures selon la direction transversale, destinée à être gonflée par remplissage d'air en son sein, la mesure de longueur de la bulle selon la direction transversale des films étant supérieure à deux fois sa mesure de diamètre selon la direction longitudinale des films.
13. Coussin pneumatique selon la revendication 12, dans lequel les premières parties formant soudures (83) adjacentes des soudures transversales comportent des extrémités qui définissent l'ouverture entre les premières parties, et chaque seconde partie formant soudure (85) est reliée aux extrémités des premières parties qui définissent l'ouverture fermée par la seconde partie formant soudure.
14. Coussin pneumatique selon la revendication 12, dans lequel les extrémités des premières parties formant soudures (83) sont pourvues de soudures supplémentaires (92) qui s'étendent transversalement aux premières parties formant soudures, et les secondes parties formant soudures sont reliées aux soudures supplémentaires (92).
15. Coussin pneumatique selon la revendication 13, dans lequel les secondes parties formant soudures (92) des soudures transversales sont disposées en suivant un motif continu (91), de sorte que les se-

condes parties formant soudures sont attenantes les unes aux autres et s'étendent à travers les bulles (65), afin que les secondes soudures divisent en outre chaque bulle en au moins deux bulles plus petites.

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16. Coussin pneumatique selon la revendication 14, dans lequel les extrémités des premières parties formant soudures (83) sont pourvues de soudures supplémentaires (92) qui s'étendent transversalement aux premières parties formant soudures, et les secondes parties formant soudures, qui ferment les ouvertures entre les premières parties formant soudures, sont reliées aux soudures supplémentaires.

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FIG. 1

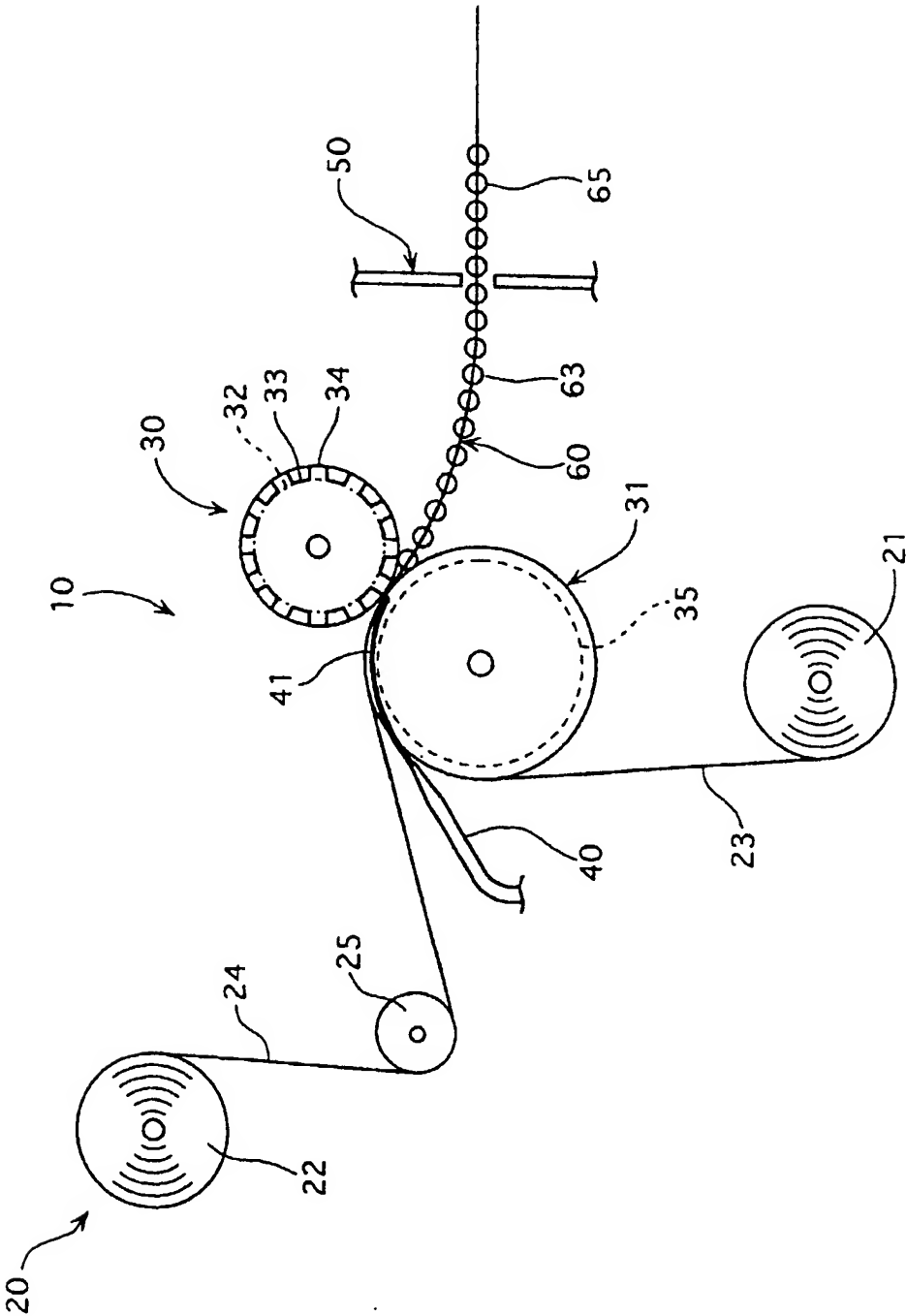


FIG. 2

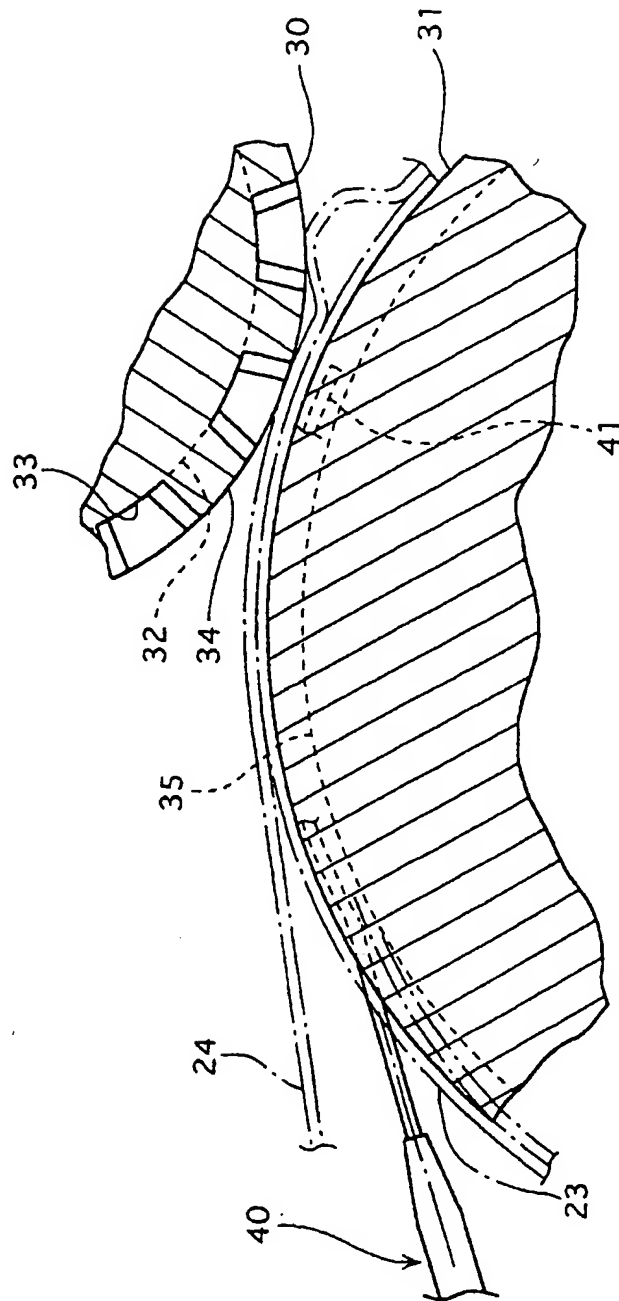


FIG. 3

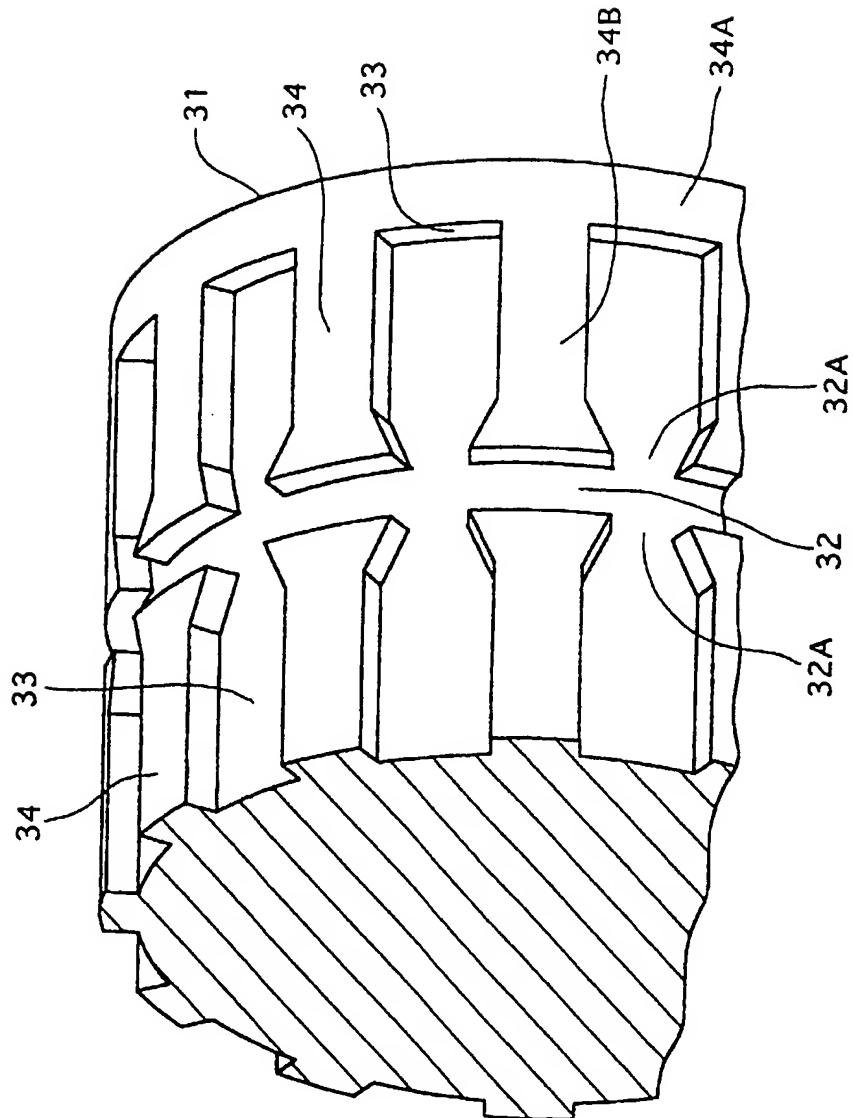


FIG. 4

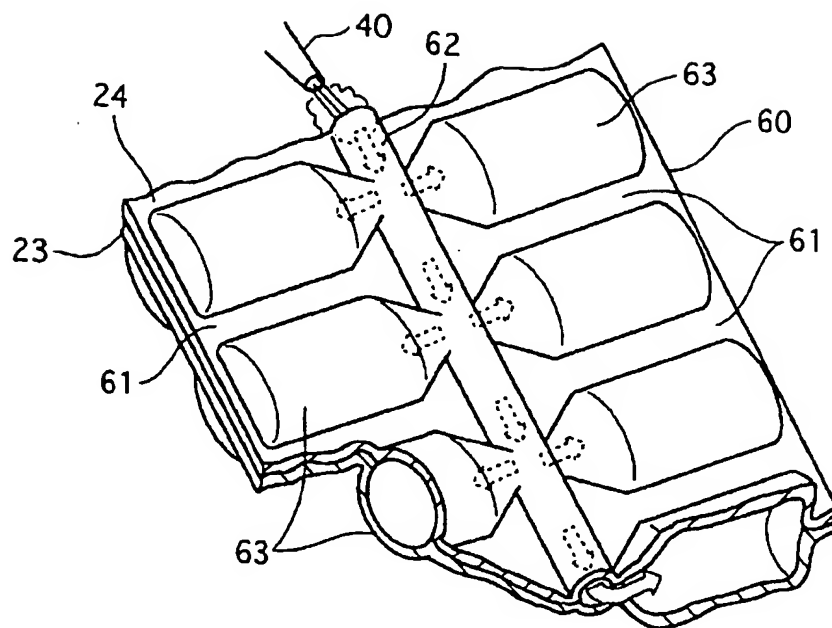


FIG. 5

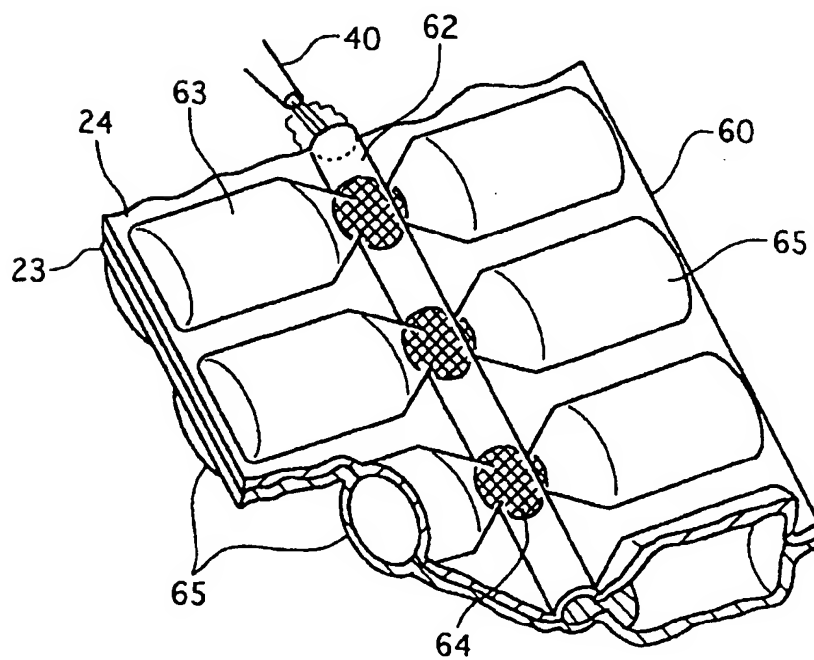


FIG. 6

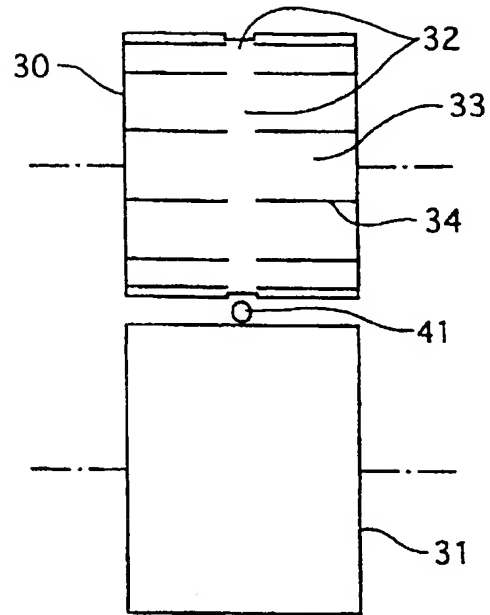


FIG. 7

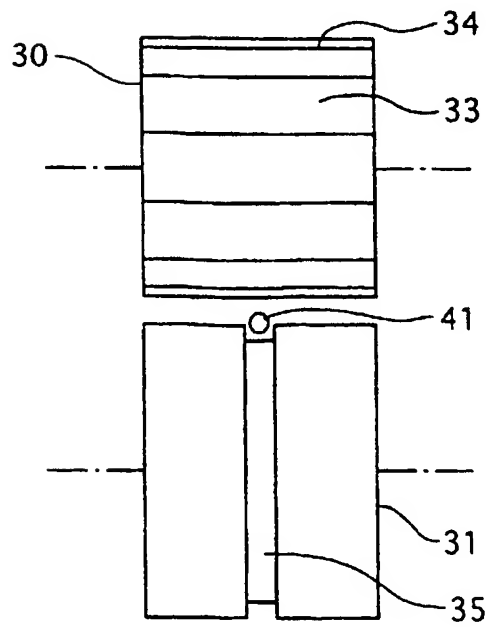


FIG. 8

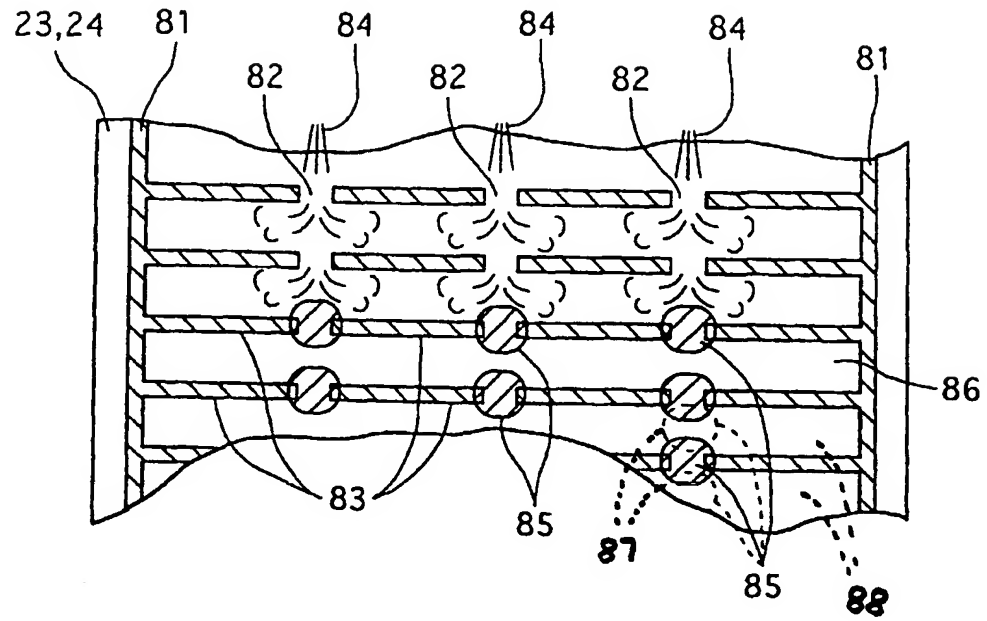
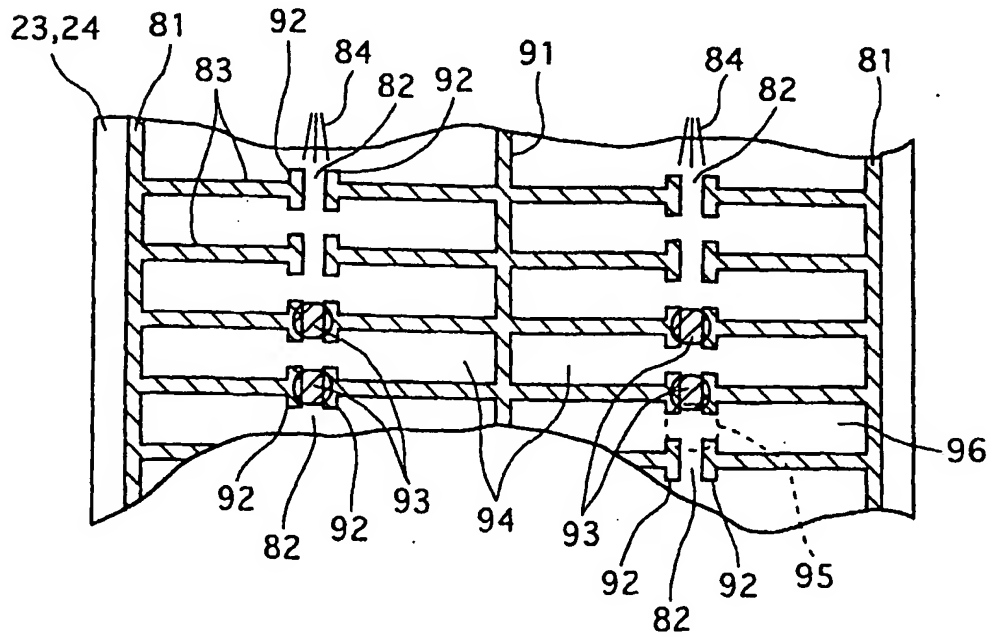


FIG. 9



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